# CHAPTER 5
# OPTIONAL PREWASH

## Section I. TYPES OF PREWASHES

### 5-1. Introduction

*a*. The prewash is designed to remove a large amount of dirt from vehicle exteriors in the most efficient way. The prewash should be flexible enough to handle the number and types of vehicles expected to use the facility. After the prewash, most vehicles will require additional washing at the wash stations so that troops can do a more detailed cleaning, reaching into crevices where a prewash might not clean. Not all vehicles will require cleaning at a prewash. Lightly soiled and smaller vehicles, such as jeeps, may proceed directly to the final wash stations.

*b*. Two types of prewash facilities have been constructed for washing tactical vehicles: baths and spray stands. The bath is a water-filled basin with water cannons mounted at each of the four corners of each lane. As vehicles are driven through the bath, persons stationed at the water cannons spray them with high -pressure water to remove the dirt. Spray stands emit high-pressure streams of water from many small nozzles directed toward vehicles driving through the facility. The bath is the recommended prewash, since it removes the bulk of the dirt, including that under the vehicle, and is the most efficient water conservative method. The spray stand is neither as efficient nor as effective as the bath for gross removal of soil from tactical vehicles.

### 5-2. Bath prewash

The bath is a water-filled basin through which vehicles drive. Three actions in the bath operate at the same time to remove dirt from tracks, from wheel wells, and tank side skirts. First, the water in the bath provides a soaking action that allows the dirt to be more easily removed. Second, troop operated water cannons placed at each corner of the bath lane spray high-pressure streams of water at the vehicles. Third, raised pipe flexors built into the bottom of the bath flex the tracks and wheels of the vehicles to aide in loosening embedded dirt. This, flexing motion is accomplished by driving the vehicle back and forth through the bath. The combination of wave action and turbulence helps remove dirt from under skirts and wheel wells. Under light to average soiling conditions, one pass through the bath may be sufficient to remove the dirt. However, for heavier soiling, vehicles may require two or more forward and reverse passes over the flexors. An additional advantage of a bath prewash over the spray stand system is that various types and shapes of tactical vehicles can be cleaned without modifying the equipment. Also, the bath is more efficient at water usage than is the spray stand, so treatment systems can be smaller. Finally, the bath can more efficiently clean “skirted” vehicle types such as the M-1 battle tank.

*a. Types of bath lanes.* Two types of lanes have been designed and developed to accommodate all type tactical vehicles. Tracked vehicle lanes are designed for use by tracked vehicles only. Large, offset flexors on the bottom of the tracked vehicle lane allow maximum flexing of tracks but make it difficult for wheeled vehicles to traverse and maneuver. Dual-purpose lanes can be used by both tracked and wheeled vehicles. In the dual-purpose lanes, the smaller pipe flexors, which are not offset, are easily traversed by wheeled vehicles. However, the smaller flexors are not as effective as the. track lane flexors for cleaning tracked vehicles.

*b. Configuration.* Dual-purpose lanes can be used in conjunction with tracked lanes at the same facility. Figure 5-1 shows a prewash design that uses both types of lanes. It is recommended that no more than three lanes be combined to form one bath. Multiple baths can be linked with walls between them. This configuration will provide maximum flexibility for the installation, since not all bath facilities will need to be filled to wash vehicles if a small group arrives. If tracked and dual-purpose lanes are combined to form one facility, the tracked lanes should be located as close as possible to the sediment basin. Most of the sediment leaving the bath will be removed from the vehicles in the tracked lanes. This layout will reduce the distance that wastewater with high suspended solids content must travel prior to primary treatment. Figure 5-2 presents a tracked lane in cross section. Signs may be required to direct users to the proper type of bath lane.

*c. Lane width.* The recommended effective width of a lane is 22 feet (6.7 meters).

*d. Bath bottom length.* The length of the bath bottom is based on the track perimeter of the largest tracked vehicle expected to use the bath. A typical lane is 50 feet (15.2 meters) long from the bottom of the entrance ramp to the bottom of the exit ramp, including the width of the trench drain opening.

*e. Water level.* The water level in the bath should be adjustable. A range of 0 to 3.5 feet (0 to 1.10 meters) is recommended for maximum flexibility. Depth of water is measured at the deepest point in the bath (fig 5-2), excluding the depth of the trench drain. Not all vehicles can operate in a 3.5-foot (1. 10-meter) water level; in these cases, it must be possible to lower the water level. Depending on the types of vehicles using the bath and the different units’ requirements, an operator can regulate the level within the recommended range. An extra 1.0 foot (30.5 centimeters) of freeboard should be added to the walls of the bath. A staff gauge or other water level indicator should be placed in the bath or painted on the side wall to guide the operator when adjusting the bath depth.

*f. Water cannons.* The bath prewash is equipped with two stages of stand-mounted fire-fighting-type hardware with nozzles, each of which can deliver the required design wash water pressure and flow to the exterior tracks or wheels of the vehicle being washed. Each bath lane is provided with a total of two primary (entrance) cannons and two secondary (exit) cannons, one at each corner of the lane. Each lever-directed cannon system consists of water supply riser, manually operated flow control valve, play pipe, and nozzle. During the first stage, a vehicle enters the bath slowly from the entrance staging area and troops aim the primary cannon water stream at it for gross removal of solids from wheels, tracks, idlers, and behind skirts and fenders. During the second stage, parts of the vehicle with soil not dislodged at the primary cannons or by submergence and flexing in the bath are exposed to the high-pressure, high-volume water stream from the secondary cannons prior to

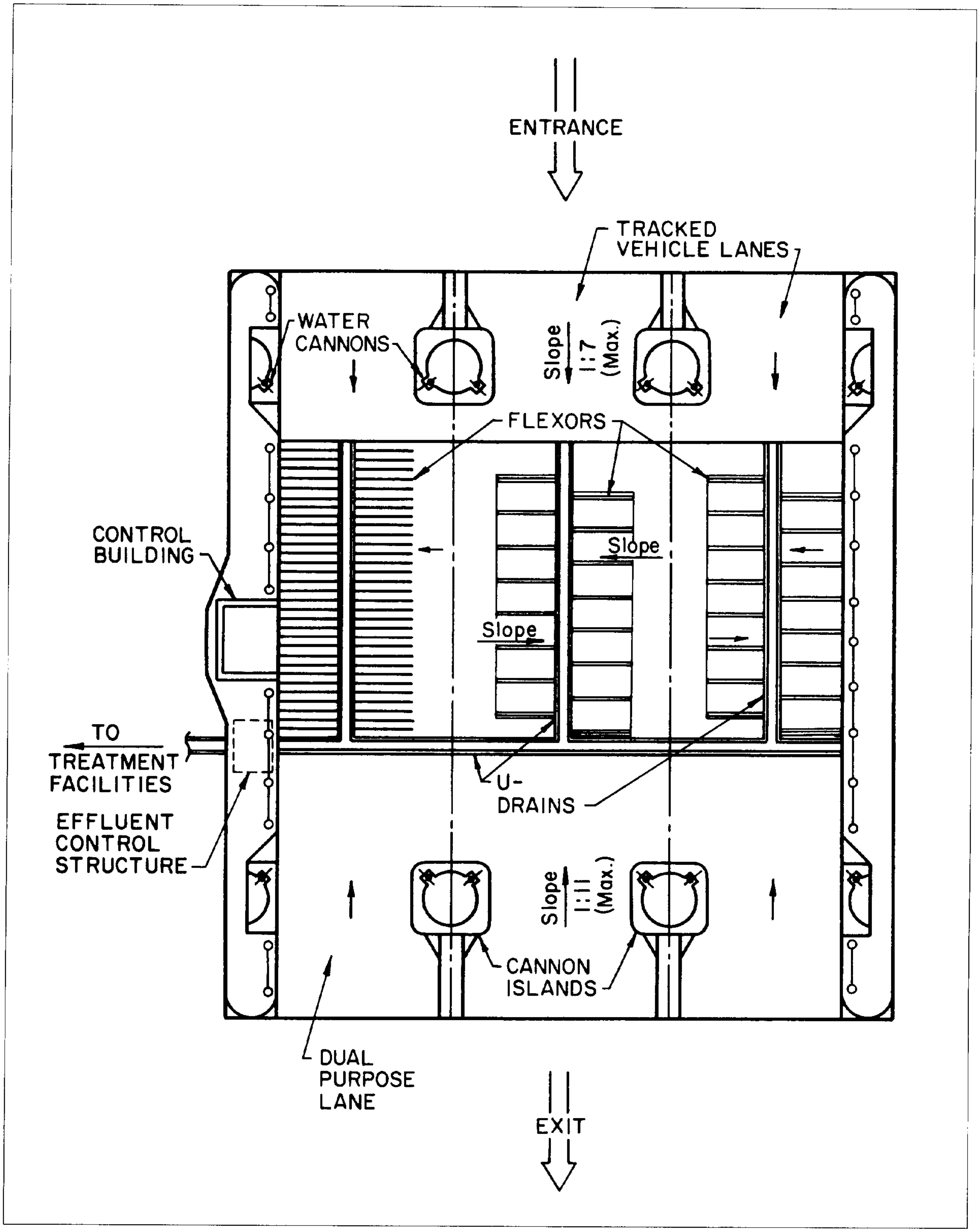


*Figure 5–1. Example combined bath lane facility—plan view.*

exiting the bath. To allow flexibility of lane usage, each water cannon system is designed to deliver and operate in the required flow and pressure ranges, regardless of whether a lane is dual-purpose or tracked.

(1) *Water pressure and flow rates.* The recommended water pressure is 100 psi (6.8 atmospheres) at the nozzles. The recommended nozzle flow rate is 80 gpm (300 liters per minute). A flow control valve shall be installed on each cannon to allow troops to stop and start the water flow. As discussed in chapter 4, pressure and flow rates are provided to facilitate pump selection and control, and to handle different soiling conditions.

(2) *Height.* The center line of the nozzle on the cannon should be 50 inches (127 centimeters) above the can pavement adjacent to the island as shown on figure 5-5.

(3) *Nozzles.* The nozzle tip shall provide a stream of water with a zero-degree spray-angle nozzle. The

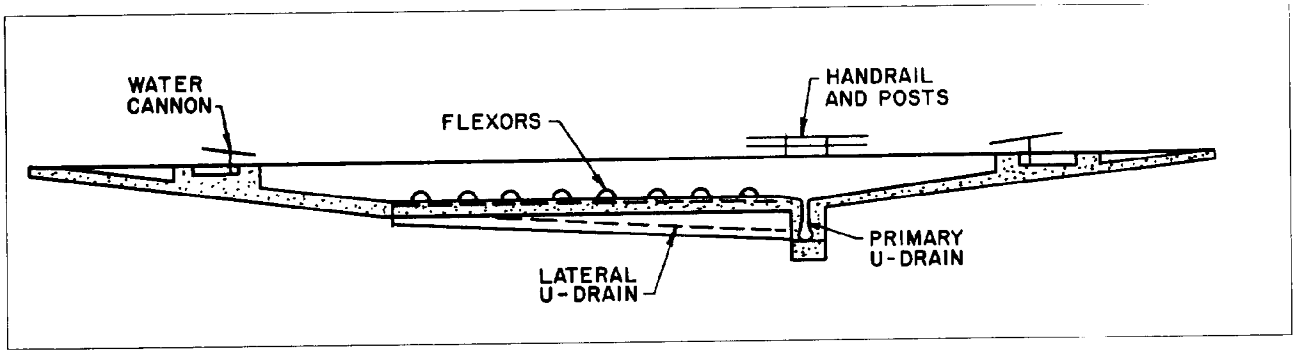


*Figure 5-2. Tracked bath lane—cross section.*

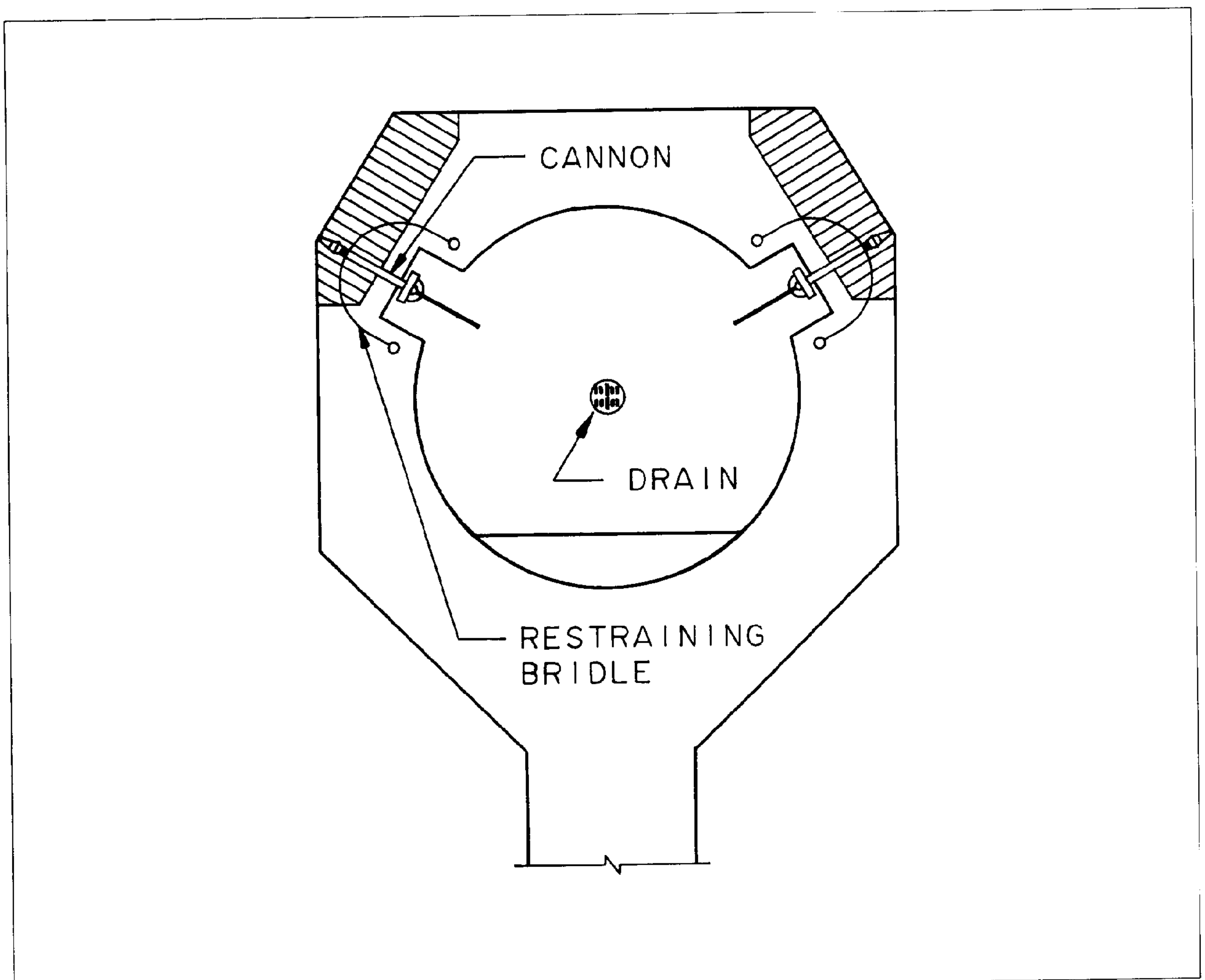


*Figure 5-3. Example inner wash islands.*

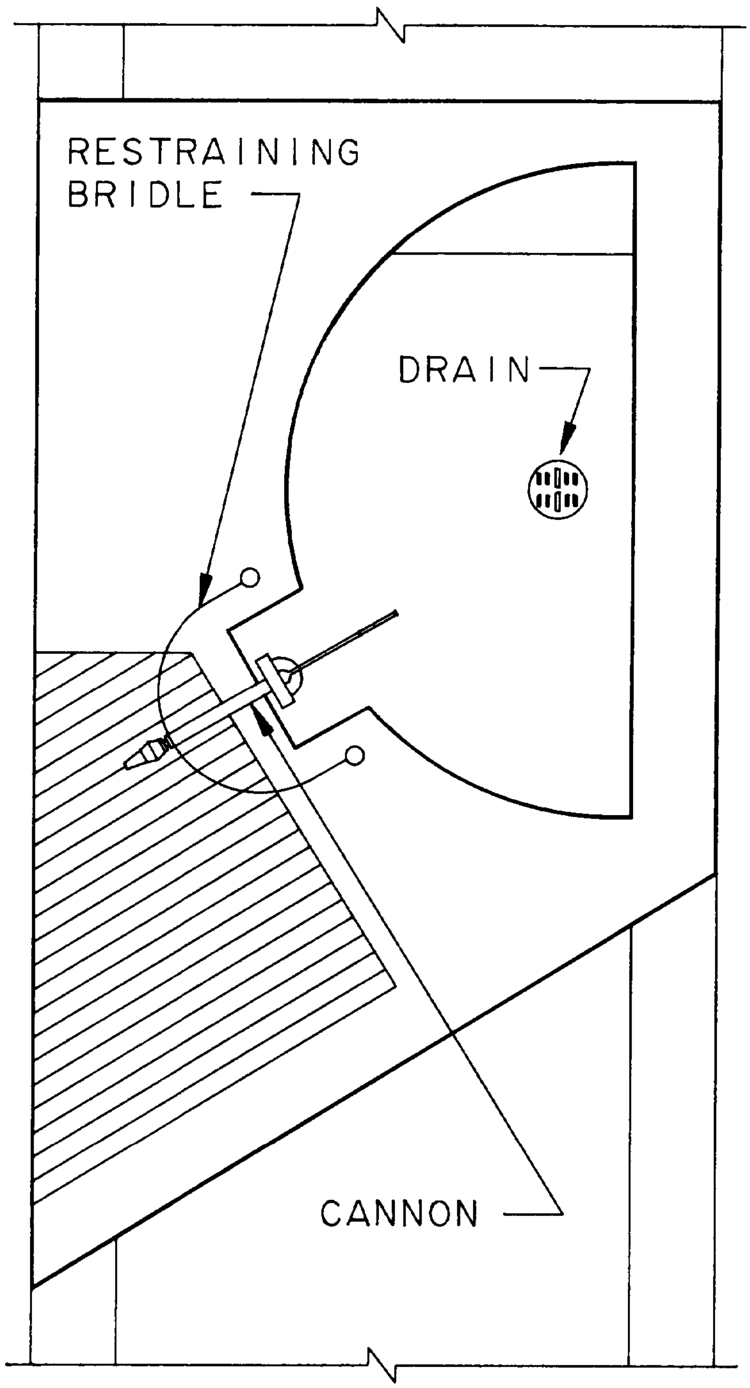


*Figure 5-4. Example outer wash islands.*

inner diameter of the nozzle orifice should be ½ inch (12.7 millimeters). The nozzle must be able to deliver pressures and flow rates within the recommended ranges with minimum losses.

(4) *Motion restriction.* Adjustable restraining bridles (fig 5-3) should be placed at each water cannon position to limit both horizontal and vertical movement. Without the restraints, personnel could accidentally spray each other during cleaning operations which could result in injury.

*g. Cannon islands.* Water cannons are mounted in concrete islands constructed at each corner of the bath lane. Figure 5-3 shows two example configurations. The concrete islands should be located on the entrance and exit ramps of the bath. Two cannons should be placed in each inner cannon island (fig 5-3). The outer islands should have one cannon per island (fig 5-4). The islands must have drainage so that troops will not be standing in water. All corner sections within the bath should be filleted to avoid the buildup of debris. Cannon island shall be designed such that they do not impede the movement of the cannons or the wash water flow stream. If the user requires, hose connections may be included in the island design for clean up purposes. Figures-S shows a cross section of the wash island.

*h. Flexors.* Flexors are grout or concrete filled, steel piping installed on the bottom of the bath lane to improve removal of encrusted dirt from under the skirts, around drive wheels, and other areas of the vehicles that cannot be cleaned by the water cannon flowstream. By driving the vehicles back and forth over the flexors, much of the dirt can be loosened and removed. The turbulence created from this action also removes dirt from hard-to-reach areas in the undercarriage, and behind side skirts. The spacing and height of the flexors cause the tracks and wheels to move in an up-and-down motion. This movement loosens dirt from the tracks and from under wheel wells and skirts. The space between the flexors also serves as a collection channel sloped toward bath lateral trench drain.

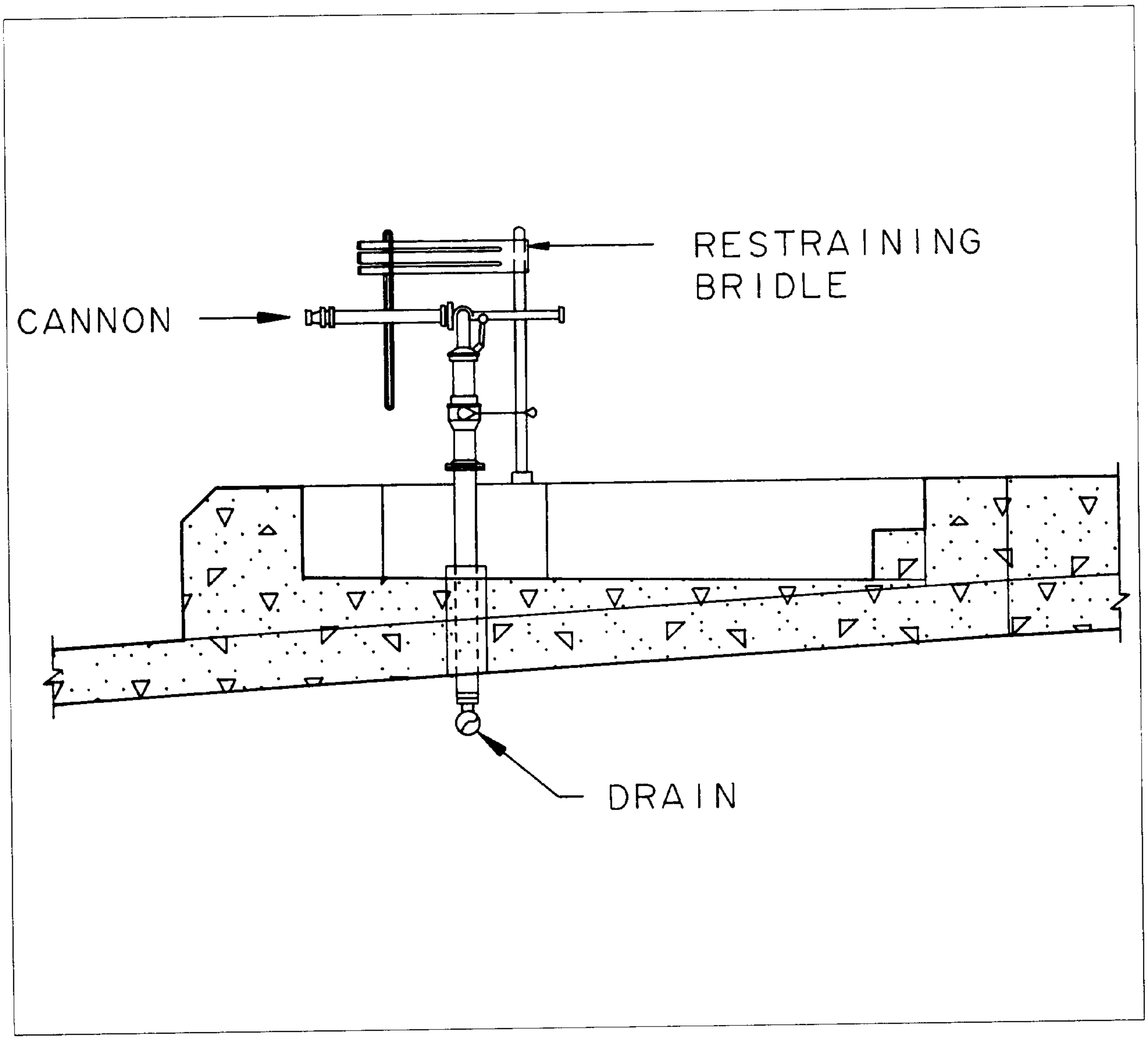


*Figure 5-5. Example cross section of a cannon island.*

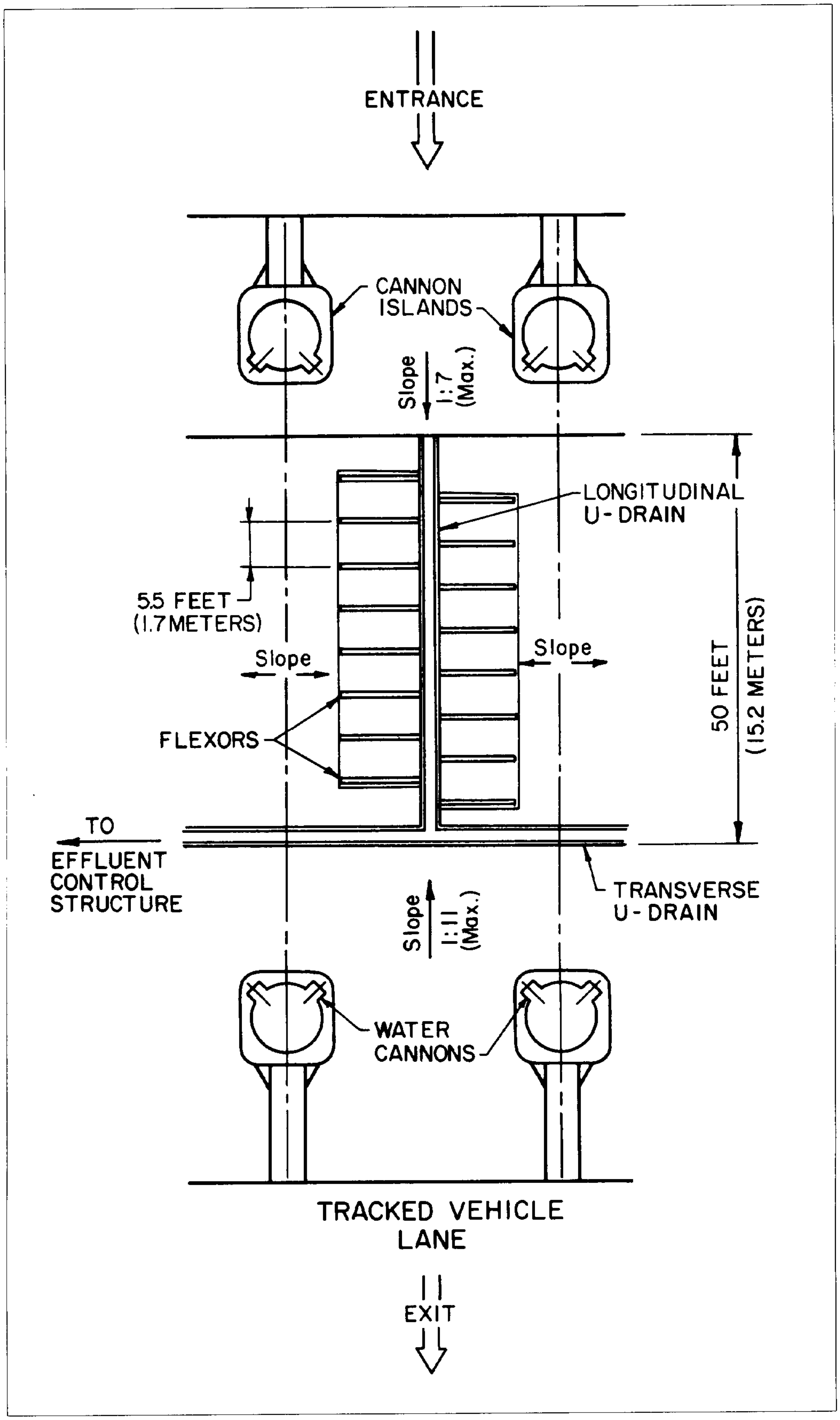


*Figure 5–6. Tracked bath lane.*

(1) *Tracked vehicle lanes.* The recommended center-to-center flexor spacing is 5.5 feet (1.7 meters). The flexors are offset (fig 5-6) to allow the vehicle's running gear to achieve the maximum flexing motion possible. Outer lanes of the bath should have the flexors extended to the side walls to prevent dirt from building up between the ends of the flexors and the walls. Each flexor in a tracked vehicle lane should be 9 inches (22.8 centimeters) high. The method of connecting or imbedding the flexors to the bottom of the bath must be able to withstand the impact of all types of vehicles using the bath.

(2) *Dual-purpose lanes.* The design of flexors in dual-purpose lanes will be similar to those in the tracked lanes. The flexors should be spaced 18 inches (45.7 centimeters) apart. The flexors shall be installed at right angles to the lane and extend from the edge of lateral trench drain in the lane to the side walls of the bath. This design prevents dirt from collecting between the wall and the flexor. The flexors are not offset (fig 5-7) in order to allow better vehicle control. Each flexor shall be 3 inches (7.6 centimeters) above the floor level and constructed in such a way to withstand the impact of both tracked and wheeled vehicles.

*i. Entrance ramp.* The slope of the entrance ramp is measured from the top of the first flexor in the bath lane. The maximum allowable slope into the bath is 1:7 (14 percent).

*j. Exit ramp.* The maximum allowable slope for the bath exit ramp is 1:11(9 percent).

*k. Ramp Slope.* Slopes selected will affect the volume of water required to fill the bath and the resulting amount of wastewater to be treated. Therefore, the maximum slopes allowable should be selected except where local conditions require flatter slopes.

*1. U-Drains.* Open u-drains shall be used to move soil-laden wastewater from the bath area to the collection system (fig 5-8). The bottom of the bath should slope toward these drains at a minimum of 2 percent to help move mud and debris into the collection system (fig 5-9).

(1) *Configuration.* A lateral u-drain is installed along the centerline of each bath lane. Each lateral drain is connected to the transverse u-drain that runs perpendicular to the lanes. This transverse drain discharges directly into the bath outlet control structure. Figure 5-10 shows how these drains are arranged.

(2) *Fill/flush system.* A fill/flush system with motorized valves is provided in the bath to allow for timed filling of the bath and movement of dirt and debris to the outlet structure when the bath is drained, flushed and cleaned. A flusher supply discharge should be placed into the uppermost end of each u-drain. The flushers will provide increased flow in the u-drains to prevent sediment deposition. The recommended flushing rate is 600 gpm (2280 liters per second) for the lateral u-drains and 900 gpm (3420 liters per second) for the primary u-drains and should be set to provide 5 fps (2.4 meters per second) velocity in the u-drain. Flushing time is arbitrarily set at 15 to 25 minutes, depending on soiling conditions. The flow rate for filling may be increased in order to fill the bath in a reasonable amount of time; a fill time of 30 minutes or less is recommended. The fill/flush procedures are controlled by the wash facility operator (see chap 4.) The system of pumps and supply piping is designed to be independent of other systems. The source of fill/flush water is the equalization basin.

(3) *Design.* U-drains are to be designed to handle the peak solids and hydraulic loadings that occur in moving wastewater to the effluent structure. A minimum grade of 2 percent is required in the drains along with 5 fps velocity to prevent settling.

(4) *Materials.* U-drains should be lined with concrete or other impervious material such as plastic, metal, or vitrified clay. The liner should have a smooth, circular finish to reduce roughness in the trench.

*m. Outlet control structure.* A moveable weir on the outlet structure is used to regulate the depth of water in the bath (fig 5-11). This weir is located at the interface of the structure and the bottom of the bath and is designed to be raised or lowered to vary the water depth. A valve or gate is located in the structure at the intersection with the transverse u-drain to allow wastewater to discharge into the structure. Weirs, valves and gates may be motorized or manually operated. The structure should be designed to minimize solids deposition.

## 5-3. Vehicle spray stands

A spray stand operates much as a commercial car wash in that the vehicle is driven into the facility and sprayed by high-pressure water from many small nozzles. This method is not suited, nor recommended, for the irregular-shaped tactical vehicles, because M-1 tanks and other vehicles with heavy side skirts cannot be cleaned effectively. The spray does not effectively remove dirt from the treads, under the skirts, and other places that are difficult to reach. Spray stands also require larger amounts of water than comparably sized bath prewash facilities. Therefore they are not recommended for use at CONUS installations.

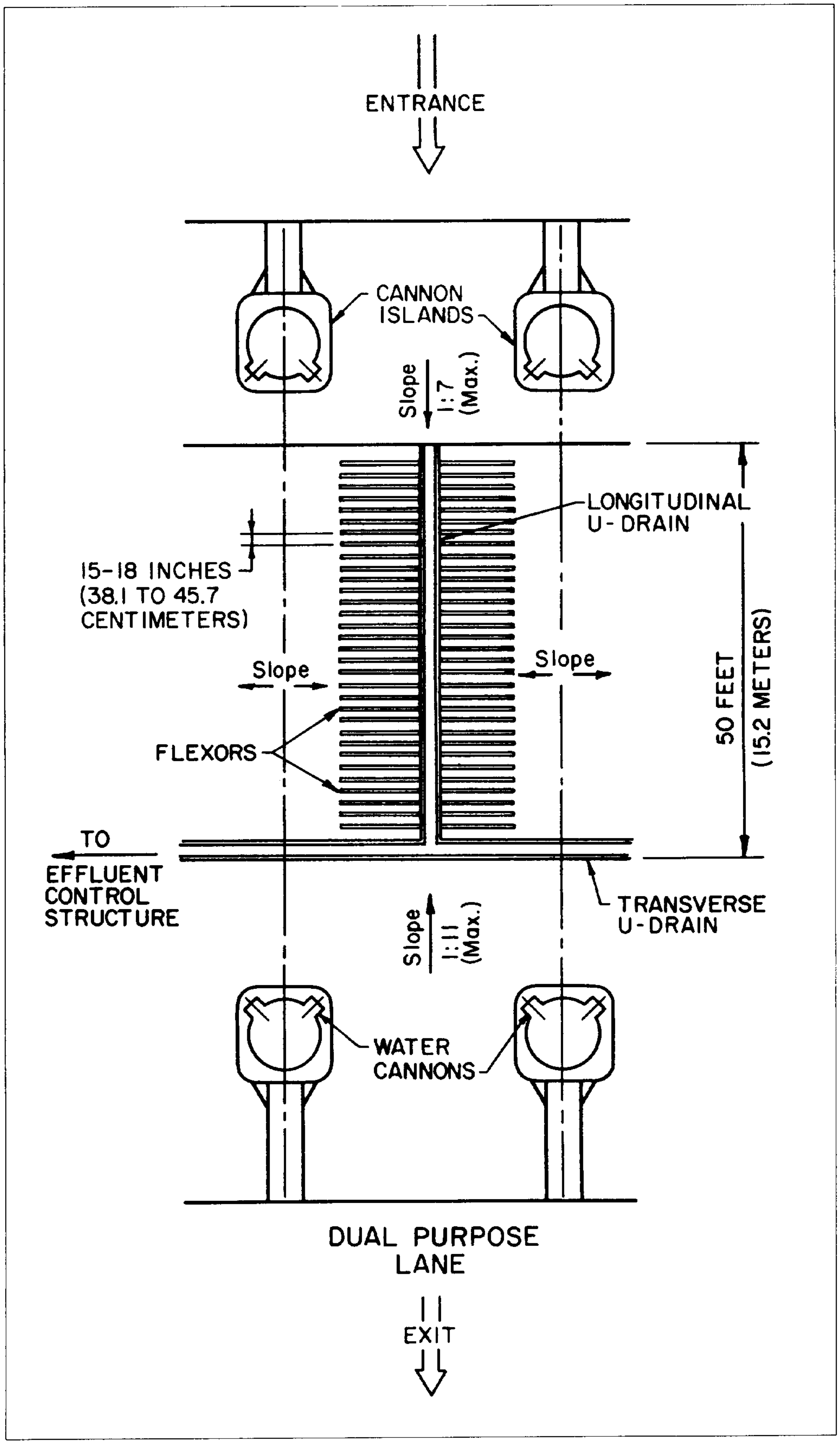


*Figure 5-7. Dual-purpose lane.*

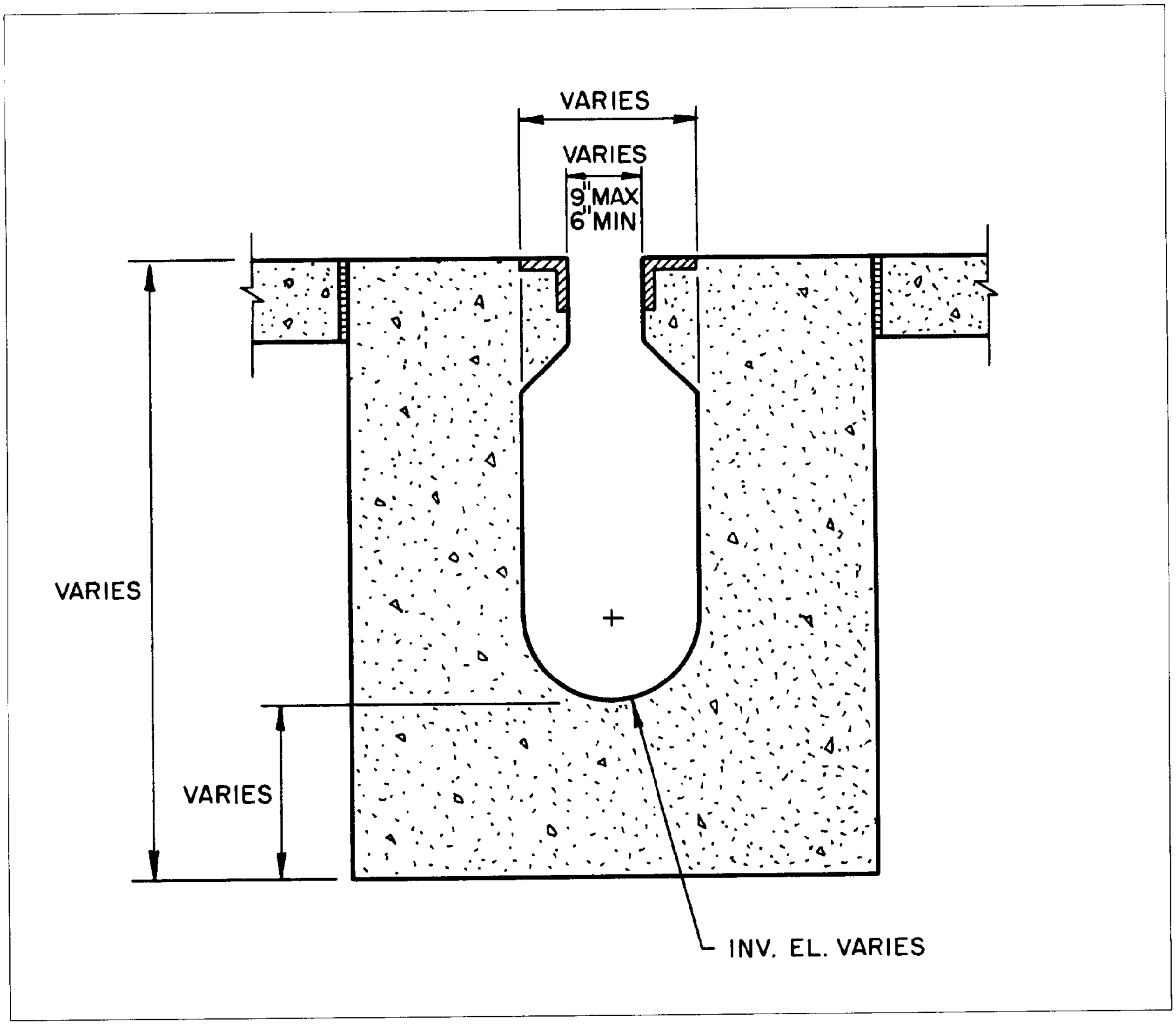


*Figure 5–8. U-Drain.*

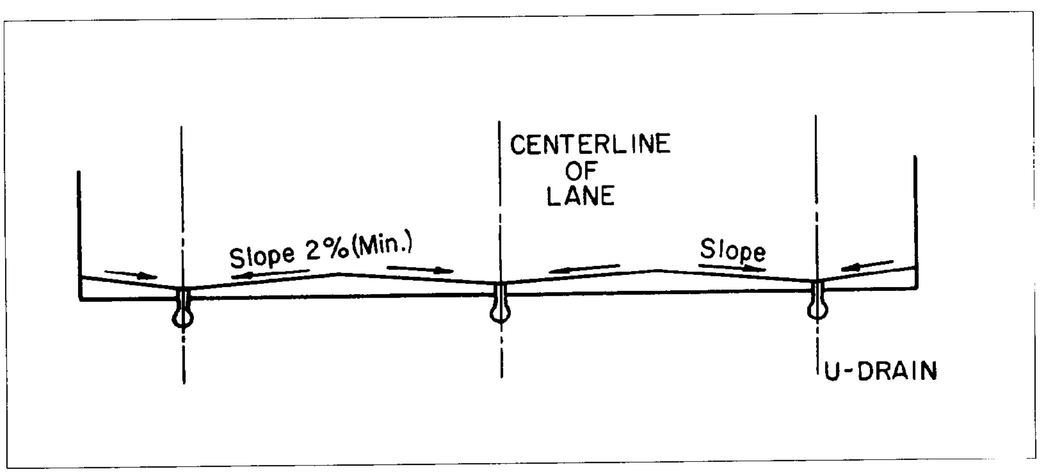


*Figure 5–9. Bath cross section.*

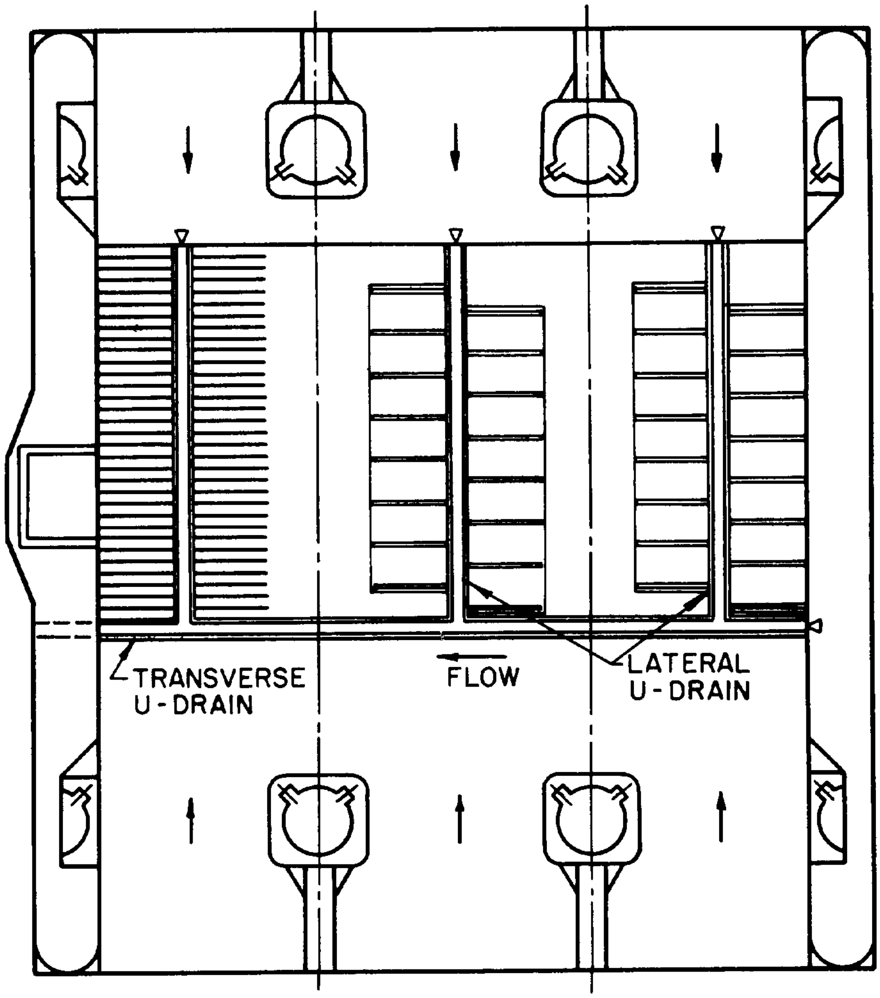


*Figure 5–10. Configuration of u-drains in the bath.*

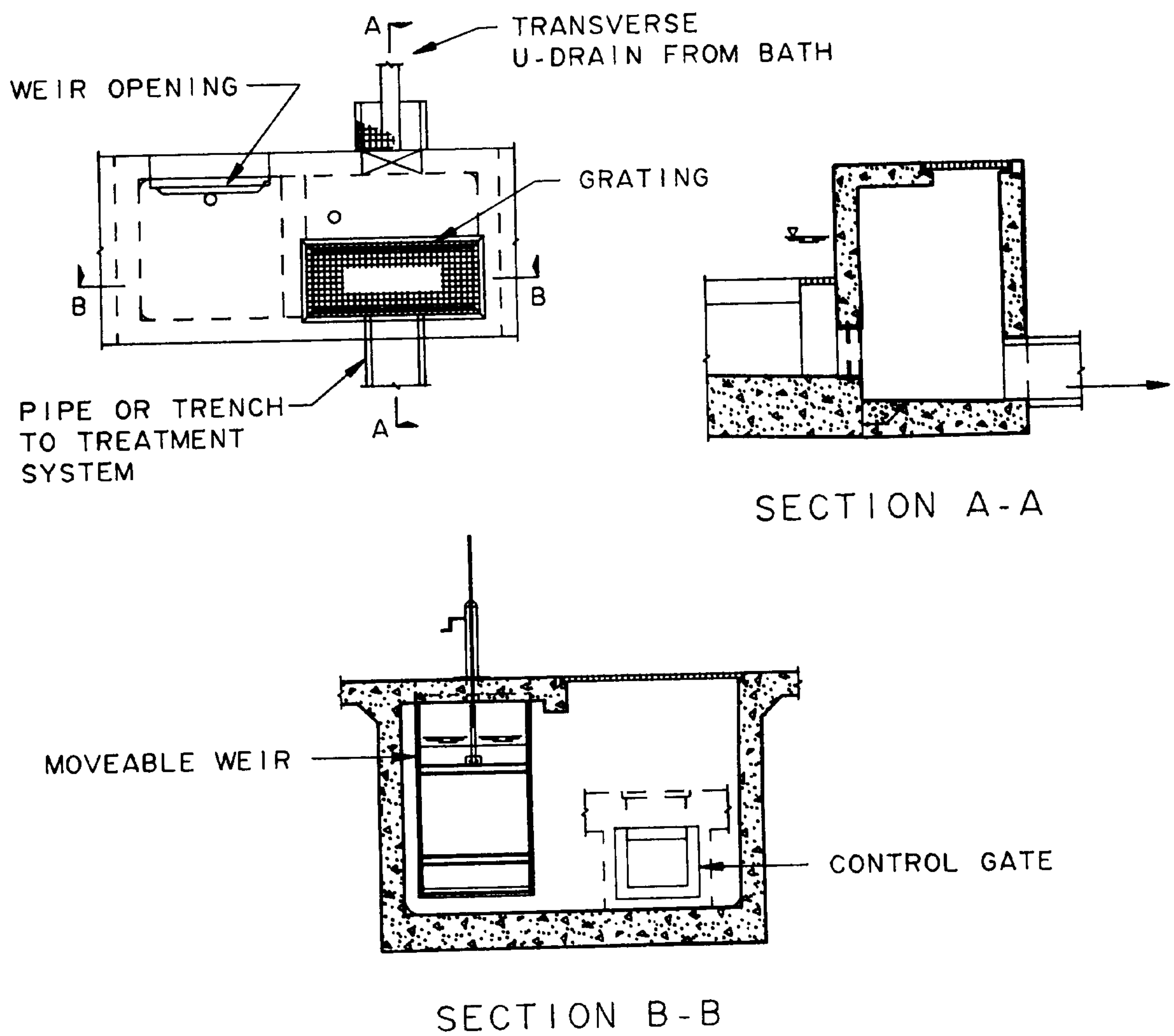


*Figure 5–11. Water level control structure.*

## Section II. BATH PREWASH SUPPORT FACILITIES

### 5-4. Wash water supply lines

Wash water supply lines transport water under pressure, from the source to the washing structures. Supply piping shall be ductile iron, steel or other material resistant to damage from water hammer. Plastic pipe is not acceptable for use in the supply piping. Frequently operated underground valves shall be accessible via manholes or valve boxes. In regions that have freezing temperatures, the system must be self-draining to prevent freezing. Adequate valving should be incorporated to allow for isolation of individual wash stations or wash positions.

### 5-5. Wastewater conveyances

The wastewater conveyances from the washing structure to the treatment system should be open trenches with a slope sufficient to produce 5 fps (1.8 meters per second) velocity. The conveyances to the treatment system shall be as straight as possible; limiting the number of turns will minimize solids deposition which can build up and block the pipes and trench drains. If closed conduit is used due to site constraints, such as the need to pass under a road, manholes must be provided at each change in pipe direction and slope and at each pipe intersection (see chap 6).

### 5-6. Bypass lane

A bypass lane is provided to allow lightly soiled vehicles to bypass the prewash and advance to the wash stations. Experience has shown that wheeled vehicles bypass the prewash most often. The recommended lane width is 22 feet (6.7 meters). The bypass lane must have positive drainage to prevent the buildup of water and sediment. When a prewash is provided, a bypass lane around the wash stations must also be provided. This enables the vehicles leaving the prewash which do not require additional washing to bypass the wash stations and advance to the final assembly area.

### 5-7. Lighting

Adequate lighting should be provided if nighttime washing operations are required by the installation. For worker safety, overhead lighting must also be installed in the areas of vehicle movement. Work-level lighting must be provided at the bath prewash so that users can see the vehicle areas to be cleaned. Lighting intensities of 3 foot-candles from most lights measured at ground level and 5 foot-candles from horizontal projecting work-level lights measured at the vehicle sides should be maintained in the washing area. All areas of adjacent hardstand such as assembly/staging and travel lanes should have a minimum lighting intensity of one foot-candle.